CURRENT CONTROL APPARATUS FOR FLUORESCENT LAMPS

FIELD OF THE INVENTION

The present invention relates to a current control apparatus for fluorescent lamps and particularly to a current control apparatus that maintains even current in a fluorescent lamp through a current feedback control approach.

BACKGROUND OF THE INVENTION

At present the light source used by liquid crystal display (LCD) of desktop computers and notebook computers, PDA, and Webpad generally is a fluorescent lamp (such as cold cathode fluorescent lamp -CCFL) actuated by a high voltage. Light is projected to a backlight plate to enable users to see the displaying picture.

LCD TV or LCD display screen with a touch film requires a greater luminosity to compensate visual requirement. As the fluorescent lamp is driven by a high voltage, when the current is higher, the luminosity also is greater. Moreover, in order to increase the luminosity, a plurality of fluorescent lamps are often being used. In such an occasion, the most important issue is to maintain the evenness of lamp current among the loads or minimize the characteristic tolerance among them. Moreover, with increased number of the fluorescent lamps, the number of control units to actuate and ignite the lamps also increases. As a result, the size of the circuit board increases.

Fabrication is more difficult and cost is higher. In the event that a plurality of fluorescent lamps are used to increase the luminosity and evenness, because of the tolerance of the fluorescent lamps, uneven tube current and luminosity often occur to the fluorescent lamps. It makes selection of the fluorescent lamps more difficult or results in more fluorescent lamps are needed to improve the luminosity and evenness. Hence the cost becomes even higher, and fabrication and adjustment are even more difficult. The conventional method for controlling the current of fluorescent lamps is generally as follow:

Refer to FIG. 1 for a conventional actuating device for driving and igniting fluorescent lamps. It includes a power supply 10, a high frequency pulse modulator 11, a power switch 12, a conversion unit 13, a piezoelectric transformer 14 and two fluorescent lamps 15 and 15'. The two fluorescent lamps 15 and 15 are jointly connected to a resistor 16 and are grounded. When a voltage is input, the power switch 12 actuates the piezoelectric transformer 14 through the conversion unit 13 to generate a high voltage output because of inverted/positive piezoelectric effect and actuate and ignite the fluorescent lamps 15 and 15'. Due to the piezoelectric transformer 14 generates a positive half cycle signal and a negative half cycle signal to actuate the fluorescent lamps 15 and 15' at the same time, and the fluorescent lamps 15 and 15'

output a positive half cycle signal and a negative half cycle signal that cancel out each other by grounding, there is no voltage drop on the resistor 16 end. As a result, the output ends of the fluorescent lamps 15 and 15' also have no voltage drop. Hence it is not possible to feed back a voltage signal to the high frequency pulse modulator 11. Therefore it is not possible to control the current of the fluorescent lamps 15 and 15' through a voltage feedback circuit. Moreover, the conventional fluorescent lamps 15 and 15' also have other problems, such as unstable electrodes, gas, and the like. They will cause abnormal operation of the current in the fluorescent lamps 15 and 15' (such as power loss). The conventional technique previously discussed uses merely one feedback circuit to connect the high frequency pulse modulator 11, and cannot control the current in the fluorescent lamps 15 and 15'. This is because the fluorescent lamps 15 and 15' have to be ignited by a high voltage to generate a high energy current. It is easy to generate high frequency noise or arc effect. This phenomenon tends to result in power loss or damages of the fluorescent lamps 15 and 15'.

SUMMARY OF THE INVENTION

Therefore the primary object of the present invention is to resolve the aforesaid disadvantages. The invention provides a current control apparatus to maintain even current in fluorescent lamps through a current feedback approach.

The present invention also provides another approach that uses a signal processor to detect output current of the fluorescent lamps and output a current compensation signal to a high frequency pulse modulator to redistribute the current.

The current control apparatus according to the invention is adopted for use on high voltage actuated fluorescent lamps to maintain current evenness in the fluorescent lamps. It includes:

a high frequency pulse modulator to provide voltage distribution signals and transmit a pulse width modulation (PWM) resonant frequency signal;

a power switch to output an actuation signal;

a conversion unit to receive the voltage distribution signal and transform voltage;

a piezoelectric transformer to receive the transformed voltage and perform voltage transformation; and

a fluorescent lamp connecting to the piezoelectric transformer and has an output end grounded.

The main features of the invention include: dividing the fluorescent lamp to a positive phase fluorescent lamp and an inverted phase fluorescent lamp; the positive phase fluorescent lamp and the inverted phase fluorescent lamp have respectively an output end to receive a current compensation signal to the high frequency pulse modulator; the fluorescent lamps are actuated by a positive half cycle and a negative half

cycle actuation signals transferred from the conversion unit; the high frequency pulse modulator detects output current of the fluorescent lamps through a signal generator to output a resonant frequency to control current variation of the fluorescent lamps.

The foregoing, as well as additional objects, features and advantages of the invention will be more readily apparent from the following detailed description, which proceeds with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a circuit diagram of a conventional current control circuit.

FIG. 2 is a circuit diagram the current control circuit of the invention.

FIG. 3 is a schematic view of current waveforms of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The current control apparatus according to the invention is adopted for use on a high voltage actuated fluorescent lamp to maintain normal operation of the current in the fluorescent lamp (CCFL) to avoid abnormal current occurred to the fluorescent lamp when actuated by a high voltage.

Refer to FIG. 2 for a current control circuit diagram of

the invention. It is for use on fluorescent lamps (as shown in the Fig. 2) 25 and 25a actuated by a high voltage to maintain evenness of the current in the fluorescent lamps 25 and 25a. It includes:

a high frequency pulse modulator 21 to receive operation voltage input from a power supply 20 and provide voltage distribution signals and transmit a pulse width modulation (PWM) resonant frequency signal through PWM;

a power switch (as shown in Fig. 2) 22 and 22a controlled by a positive half cycle signal and a negative half cycle signal of the PWM resonant frequency signal and outputs an actuation signal;

a conversion unit (as shown in Fig. 2) 23 and 23a that is an inductor to receive the voltage distribution signals and transform the voltage distribution signals and voltage;

a piezoelectric transformer (as shown in Fig. 2) 24 and 24a to receive the transformed voltage from the conversion unit 23 and 23a, and perform voltage transformation; and

a fluorescent lamp (as shown in Fig. 2) 25 and 25a that is a CCFL connecting to the piezoelectric transformer 24 and 24a, and has two output ends connecting respectively to a resistor (as shown in Fig. 2) 26 and 26a, then are grounded.

Refer to FIG. 3 for the current signal waveforms of the invention. The invention has the following features: the fluorescent lamps 25 and 25a are divided into a positive phase

fluorescent lamp 25 and an inverted phase fluorescent lamp 25a; the positive phase fluorescent lamp 25 is actuated by a positive half cycle actuation signal 240 sent from the power switch 22 and outputs a first current signal 250, while the negative phase fluorescent lamp 25a is actuated by a negative half cycle actuation signal 241 sent from the power switch 22a and outputs a second current signal 251. When the first current signal 250 is at the positive half cycle, the second current signal 251 is at the negative half cycle (referring to FIG. 3). A signal processor 27 processes the first current signal 250 at the positive half cycle and generates a current compensation signal 270a to the high frequency pulse modulator 21 which then outputs a resonant frequency to control the current variation of the fluorescent lamps 25 and 25a. On the contrary, when the first current signal 250 is at the negative half cycle, the second current signal 251 is at the positive half cycle (referring to FIG. 3). The signal processor 27 processes the second current signal 251 at the positive half cycle and generates another current compensation signal 270b to the high frequency pulse modulator 21 which then outputs a resonant frequency to control the current variation of the fluorescent lamps 25 and 25a. The first current signal 250 and the second current signal 251 have a phase difference of 180 °. The signal processor 27 is a differential rectification circuit or a full-wave rectification circuit to rectify the first current

signal 250 and the second current signal 251 in a full-wave fashion to generate the current compensation signal 270 (as shown in FIG. 3). The high frequency pulse modulator 21 determines and outputs the resonant frequency to even the current in the fluorescent lamps 25 and 25a to prevent abnormal current from occurring and causing power loss or damaging of the fluorescent lamps 25 and 25a.